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(71) Applicant (for all designated States except US): ADVANCED MINING TECHNOLOGIES PTY. LTD. [AU/AU]; 2 Finn Close, Mt. Pleasant, NSW 2749 (AU).

(72) Inventor; and

(75) Inventor/Applicant (for US only): HARDCASTLE, Philip, J. [AU/AU]; 2 Finn Close, Mt. Pleasant, NSW 2749 (AU).

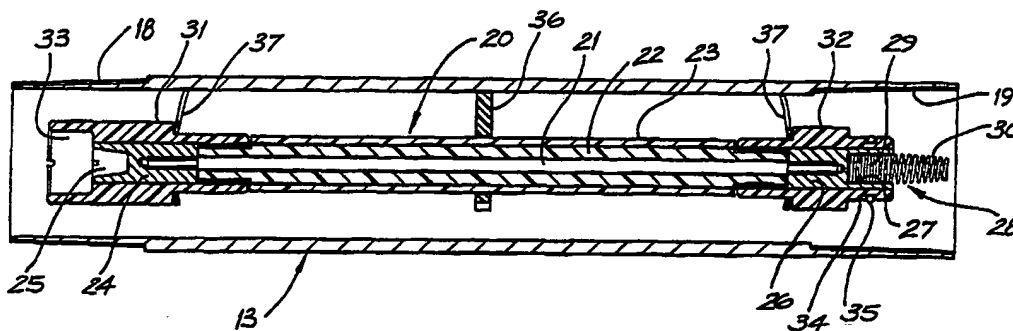
(74) Agents: HALFORD, Graham, W. et al.; Halford & Co., 1 Market Street, Sydney, NSW 2000 (AU).

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(54) Title: MODULAR DRILL PIPE SECTION



(57) Abstract

A modular drill pipe section (13) for the transmission of drill navigation data is engageable with like sections and is provided with a coaxially mounted conductor (21) insulated from the pipe interior and providing a space between the conductor and the pipe wall for the passage of drill operating fluid, connectors (24, 26, 28) being provided at each end of the conductor positioned to engage with connectors of like conductors upon coupling of pipe sections.

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## MODULAR DRILL PIPE SECTION

## FIELD OF THE INVENTION

5 This invention relates to drill navigation systems of the kind used, for example, in underground mining, in which drill navigator equipment is mounted at or near a drill bit at the end of a drill pipe string, data  
10 signals from the navigator equipment being passed to a monitoring and control system located outside the hole being drilled.

## SUMMARY OF THE INVENTION

15 In accordance with the invention each section of drill pipe is provided with a coaxially mounted conductor, insulated from the pipe interior and providing a space between the conductor and the pipe wall for the  
20 passage of drill operating fluid, connector means being provided at each end of the conductor engagable with connectors of like conductors upon coupling of pipe sections.

The invention allows this to be achieved in a manner  
25 suitable for use in explosive environments such as coal mines.

## BRIEF DESCRIPTION OF THE DRAWINGS

30 In the drawings,  
Fig. 1 is a schematic cross-section of a bore-hole drill site;  
Fig. 2 is a sectional elevation of a drill pipe section embodying the present invention;  
35 Fig. 3 is an end elevation of the drill pipe section of Fig. 2; and

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Fig. 4 is an end elevation of a spacer.

As shown in Fig. 1, a bore hole 10 is drilled into a coal seam 11 by means of a drilling rig 12, from which  
5 extends a string of pipe sections 13, each of which may be, for example, 3m long. The pipe sections carry water under pressure from the rig 12 to a drill motor 14 which is operated by the water and which drives a bit 15.

10 Mounted behind the drill motor is a so-called downhole drill monitor 16, which includes a three-axis magnetometer and a three-axis accelerometer with processing electronics, the latter producing a data  
15 signal for interpretation by remote drill display console and control equipment at 17.

The invention provides drill sections 13 which  
20 reliably carry the data signal from the monitor 16 to a water swivel S at which the signal is taken off the pipe string.

As shown in Fig. 2, in this embodiment of the invention the pipe section 13 is provided at its ends with  
25 complementary tapered screw threads 18 and 19. Mounted within the pipe section is a conductor and connector assembly 20 consisting of a central conductor 21 which may be of brass, the major portion of the length of which is covered by an insulating  
30 sheath 22 of a suitable dielectric material such as polypropylene, which is in turn surrounded by a sleeve of glass-reinforced plastics 23.

Each end of the conductor 21 extends beyond the sheath  
35 22 and is threaded to receive a connector element. A female element 24 suitably of brass is provided at its outer end with a conically tapered cavity 25, while a

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male element consists of member 26 also suitably of brass having a cylindrical cavity 27 at its outer end, this cavity housing a helical spring 28 which will be described in more detail below.

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The element 24 and the member 26 are surrounded by respective sleeves 31 and 32 which are engaged with the sheath 22 by means of threaded ends which are provided on the sheath. The female sleeve 31 has a cylindrical cavity 33 at its open end dimensioned to receive the male end 34 of the sleeve 32 of a further pipe section. The ends 34 are provided with a sealing O-ring 35.

15 The conductor assembly is mounted within the pipe section by means of a central spacer 36 shown in Fig. 4, which may be of plastics material such as polyvinyl chloride, and which is preferably located away from the midpoint of the pipe section to minimise the risk of harmonic vibration, and a pair of spring steel locators 37 which locate against shoulders provided on the sleeves 31 and 32, and bear against the inner wall of the pipe section. It will be observed that the locators are slightly oppositely dished and are oppositely directed, so that any longitudinal movement of the conductor assembly will be resisted by one or the other being forced into stronger engagement with the pipe wall. The spacer 36 and the locators 37 are in the form of spiders with three legs, to enable the passage of water through the pipe section.

The spring connector element 28 has a tightly wound cylindrical base section 29 dimensioned to fit tightly within the cavity 27, and a tapered openly wound outer section 30, which upon engagement of a pair of similar pipe sections, enters the cavity 25 of the female

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element 24. The taper and pitch of the portion 30 is such that this portion of the spring element progressively collapses within the cavity 25, conforming to the wall taper of the cavity and providing multiple points of connection with the element 24. Preferably to assist in this action, the pitch of the portion 30 increases towards its outer end.

Because the pipe sections are threaded, their engagement and the collapsing of the spring section 30 will be accompanied by a wiping action between that portion and the surface of the cavity 25, which will have the effect of removing dirt which may have been deposited on the surfaces, and the open turns of the portion 30 enable this dirt to escape into the interior of the spring. In this way a reliable electrical connection is facilitated.

The direction of winding of the spring element is chosen so that upon unscrewing of the pipe sections 13, the relative rotation between the spring and the wall of the cavity 26 will tend to tighten the engagement of the spring within the cavity, so that the spring will be retained in that cavity upon disengagement. Thus as shown for right-hand threaded pipe sections, the spring is wound clockwise from the base to the outer end.

In this way the coupling together of pipe sections produces a coaxial transmission line consisting of the inner conductor sections 21 and the pipe sections 13. The transmission line has a characteristic impedance in a typical case of approximately 50 ohm.

It will be understood that the illustrated embodiment of the invention represents but one example of the way

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in which the principles of the invention may be  
carried into effect.

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## CLAIMS:

1. A modular drill pipe section for the transmission of drill navigation data, including a pipe casing section engagable with like casing sections and provided with a coaxially mounted conductor, insulated from the pipe interior and providing a space between the conductor and the pipe wall for the passage of drill operating fluid, connector means being provided at each end of the conductor positioned to engage with connectors of like conductors upon coupling of pipe sections.
2. Apparatus according to claim 1 in which said conductor is surrounded by electrically insulating material and located by means engaging the wall of the pipe section, said means allowing for the flow therepast of drill operating fluid.
3. Apparatus according to claim 2 wherein said means resiliently engages the wall of said pipe section to oppose relative longitudinal movement between said conductor and the wall.
4. Apparatus according to claim 1 wherein said connector means at a first end of said conductor includes a frusto-conical socket and said connector means at the other end of said conductor includes a spring element having a tapered substantially helical portion dimensioned to engage within the socket of a coupled pipe section.
5. Apparatus according to claim 4 wherein said spring element is dimensioned to progressively collapse during engagement within said socket.
6. Apparatus according to claim 5 wherein said pipe

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section engages a with a similar pipe section by relative rotation therebetween.

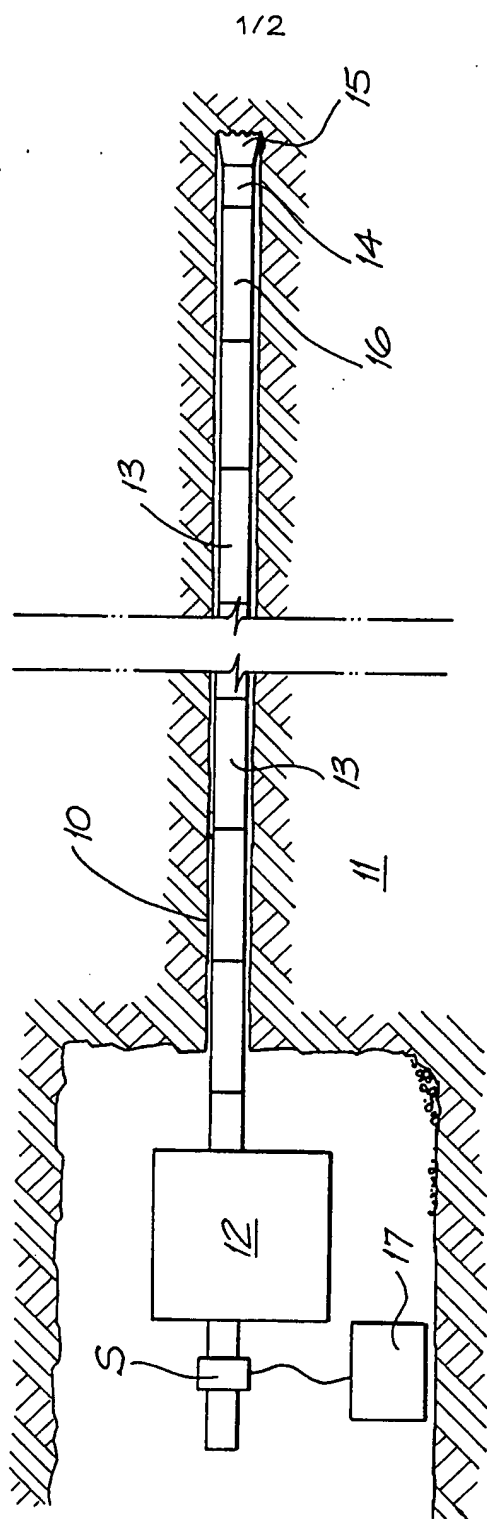


FIG. 1

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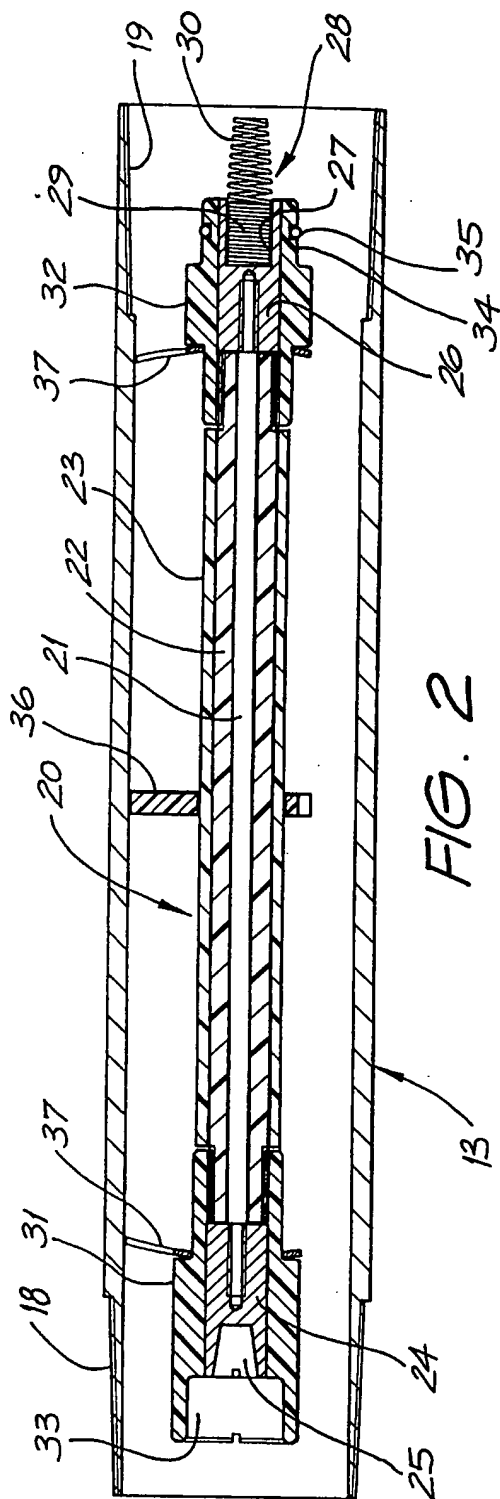


FIG. 2

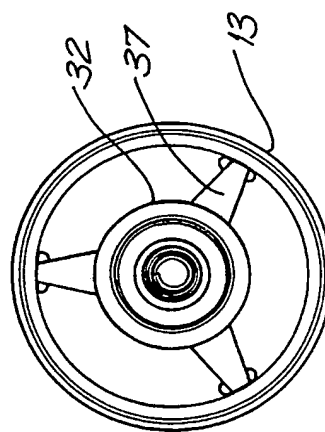


FIG. 3

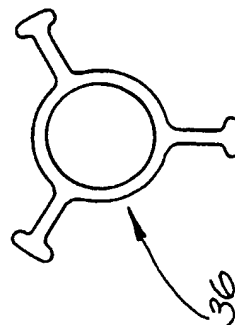
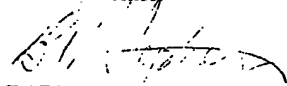


FIG. 4

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU 95/00084

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> Int. Cl. <sup>6</sup> E21B 17/042, 47/12					
According to International Patent Classification (IPC) or to both national classification and IPC					
<b>B. FIELDS SEARCHED</b>					
Minimum documentation searched (classification system followed by classification symbols) IPC(6) : E21B 17/042, 47/12					
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU : IPC as above					
Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)					
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>					
<b>Category*</b>	<b>Citation of document, with indication, where appropriate, of the relevant passages</b>	<b>Relevant to Claim No.</b>			
A	EP,A, 0186599 (SCHLUMBERGER TECHNOLOGY CORPORATION) 2 July 1986 (02.07.86)				
A	US,A, 4842059 (HALLIBURTON LOGGING SERVICES, INC.) 27 June 1989 (27.06.89)				
A	MANUAL OF DRILLING TECHNOLOGY, pages 451-452 "Electro Drills" Published by A.A. Balkema, Rotterdam, 1985				
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> Further documents are listed in the continuation of Box C.         </div> <div style="width: 45%;"> <input type="checkbox"/> See patent family annex.         </div> </div>					
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Name and mailing address of the ISA/AU  AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA  Facsimile No. 06 2853929		Authorized officer   <b>BARRY STEPHENS</b>  Telephone No. (06) 2832106			